

Within this floor is sunken the great inner gorge, 3000 feet deep, with nearly vertical walls. The width of the inner gorge is about the same as the depth, or 3000 to 3500 feet. The strata exposed in this section are 4500 feet of Carboniferous (the entire local series), and 500 or 600 feet of Lower Silurian or Primordial. The speaker then indicated the salient features of the topography and stratigraphy of the country in the vicinity of the chasm. It is for the most part a desert plain, surfaced by the summit beds of the Carboniferous, with low mounds or flats consisting of remnants of the Permian, and occasionally a small remnant of the Lower Trias. Forty miles north of the chasm is found the main Permian mass lying as a higher bench or terrace terminated southwardly by a cliff. Proceeding northward, the Trias, the Jurassic, the Cretaceous, and the Lower Eocene systems are successively encountered, each at intervals of five to ten miles. Each of these formations is likewise terminated southwardly by a great cliff, and the whole series, from the Permian to the Eocene inclusive, constitute a stairway leading up to the high plateaux of Utah. Capt. Dutton stated that conclusive evidence has been found that these terraced formations, thus abruptly terminated, once extended southward across the Grand Cañon and far into Central Arizona, but have been denuded down to the summit of the Carboniferous. The total thickness of beds removed was a little over 10,000 feet, and the eroded area was from 13,000 to 15,000 square miles. This area is called by him the Grand Cañon district. The erosion began about the middle of Eocene time, and has continued uninterruptedly to the present. The cutting of the Grand Cañon is merely the closing episode of a much greater work. The excavation of the present cañon is a comparatively recent geological event, and Capt. Dutton is of the opinion that its origin does not antedate the Pliocene period. He then explained some of the more important considerations and conditions upon which the cutting of cañons depends, and showed the natural mechanical process of creating and maintaining the singularly beautiful and architectural profiles of the cliffs, and how their wonderfully constant outlines are preserved. He then entertained his audience by a graphic and enthusiastic description of the phenomenal scenery revealed in the wider and deeper portions of the chasm.

THE geology of Spain being yet very imperfectly known, we are glad to find in a recent number of the *Boletín* of the Geographical Society of Madrid the continuation of Don Juan Vilanova's paper on the geological survey of the province of Valencia, being a description of the Tertiary formation of the province. This formation consists of conglomerates and clays covered with marls, sandstones, grits, and gypsum, with beds of lignite and peat. The surface is undulated, forming low hills with gentle slopes, but intersected with deep ravines, or barrancos, or terrace-like, with deep ravines, along which streams flow in cascades during the rainy season. Wide lacustrine basins at Bicorp, which were considered by Verneuil as Cretaceous, belong also to this formation.

THE Jubilee Meeting of the British Medical Association will be held at Worcester, on August 8-11. The president-elect is Dr. William Strange, senior physician to the General Infirmary, Worcester.

PROF. HAECKEL is giving some account of his recent visit to Ceylon and India in the *Deutsche Rundschau*.

WE read in the "Diario de Manila" that a German ethnologist, Dr. Schadenberg, of Breslau, has now resided for some time amid the savage tribes in Sibotam, at the foot of the Volcano of Apo, for the purpose of studying the ethnography of the tribes of Atas, Bagobos, Manobos, Mandayas, Tagacaolos, Vilanes, Samales, Sanguiles, Moros, and Guiangas. All these races differ materially in language, religious customs, attire, and habits, so that Dr. Schadenberg has certainly selected a rich field of study.

IN a brochure published by Messrs. Sampson Low and Co., Col. Burnaby has given an interesting narrative of his recent balloon trip across the Channel.

THE additions to the Zoological Society's Gardens during the past week include a Black-eared Marmoset (*Hapale fenicillata*) from South-East Brazil, presented by Mrs. Davidson; a Ring-tailed Lemur (*Lemur catta* ♂) from Madagascar, presented by Dr. J. Lea, M.R.C.S.; two Grey-backed White-eyes (*Zosterops dorsalis*) from Australia, presented by Mr. J. Abrahams; a Jardine's Parrot (*Paeocephalus gularis*) from West Africa, presented by Capt. H. Hope Keighley, 2nd W.I. Regt.; three Zebra Waxbills (*Estrela subflava*), a Shining Weaver Bird (*Hypochera nitens*) from Africa, two Amaduvade Finches (*Estrela amandava*) from India, a Crimson-eared Waxbill (*Estrela phanictis*) from West Africa, presented by Mrs. Beauclerk; a Common Buzzard (*Buteo vulgaris*), British, presented by Mr. J. C. S. Roche; a Common Partridge (*Perdix cinerea* ♂), British, presented by Mr. H. T. Bowes; a Long-tailed Copsychus (*Copsychus saularis*) from India, deposited; a Manchurian Crossopiton (*Crossopiton manchuricum* ♂) from North China, two Japanese Pheasants (*Phasianus versicolor* ♂ ♀) from Japan, an Amherst Pheasant (*Thaumalea amherstiae* ♀), a Gold Pheasant (*Thaumalea picta* ♀) from China, a Lineated Pheasant (*Euplocamus lineatus* ♂) from Tenasserim, two Black-backed Kaleeges (*Euplocamus melanotus* ♂ ♀) from Sikkim, two White-crested Kaleeges (*Euplocamus albo-cristatus* ♂ ♀) from North-West Himalayas, two Hasting's Horned Tragopans (*Cerionis hastingii* ♂ ♀) from North India, purchased; a Rifle Bird (*Ptiloris paradisea* ♂) from Australia, received on approval; a Sambur Deer (*Cervus aristoteles* ♀), a Gaimard's Rat Kangaroo (*Hypsiprymnus gaimardi*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

A SYSTEMATIC SEARCH FOR COMETS.—The necessity of a more rigorous and systematic examination of the heavens with the view to the early discovery of telescopic comets has been somewhat forcibly exemplified of late years, and it is satisfactory to learn that American observers are taking the initiative vigorously in this direction. A partial arrangement for regular sweeping has been made, and is detailed in a circular issued from the office of the *Science Observer*, in which also further cooperation is invited, and it is to be hoped that amateurs here with the necessary instruments, and time at command, will actively second the efforts that are being made in the United States, to further our knowledge of these, as yet, in a cosmical sense at least, problematical bodies. Mr. W. F. Denning, of Bristol, after proving his extraordinary patience and perseverance in the observation of meteors, and who has done excellent work in that class of observation, has for some months instituted a search for comets in such quarters of the sky as his position best commanded, and has made, as we know, a most notable beginning by the detection of the comet of short period, which astronomers will recognise in future as "Denning's comet." He has kindly afforded us an opportunity of perusing a letter addressed to him by Mr. J. Ritchie, jun., of Boston, U.S., from which we may be pardoned for making the following extract:—"We wish it understood that although from the circumstances of the organisation, the majority of observers are here in this country, still we do not wish to make anything exclusive or national about it, and are simply after the most scientific ways of doing certain things, and are ready to receive that advice which the experience of others renders them competent to give." Mr. Denning has found a coadjutor to divide with him the examination of the eastern sky in the morning hours, and there should be little difficulty in arranging for other amateurs here to take part in an evening search. Two or more observers in the other hemisphere will be needed to complete the regular scrutiny of the whole sky, and we do not anticipate that the scheme will be rendered imperfect for want of them.

It would be an easy matter to cite a number of cases where the earlier detection of comets would have materially aided our knowledge of their motions in space, and probably of their gradual development in approaching the sun. We may refer to

two cases of recent occurrence. The fifth comet of 1877 was detected by Tempel on October 2, when its south declination was already 10° , and its motion towards the south did not permit of its being followed after October 14, when the last observations were made at Leipsic and Milan. On the orbit being calculated, it was found that the comet had passed the perihelion as early as the end of June, and, further, that it had escaped observation before perihelion, when in a much more favourable position than at the time of its discovery by Tempel. Thus, on April 5, as the moon was drawing away from the evening sky, it was in R.A. 161° , Decl. $+57^\circ$, consequently a circumpolar object in these latitudes, its distance from the sun was 1.69 , and from the earth 1.05 , and the intensity of light, expressed in the usual manner, was 0.32 . At its actual discovery, on October 2, the distance from the sun was 1.86 , and from the earth 0.88 , consequently the intensity of light was 0.36 , or virtually the same as on April 5. But the orbital arc available for the final calculation of the elements was less than $4\frac{1}{2}^\circ$, whereas if the comet had been detected in its more favourable position towards the end of the first week in April, there would have been available for this purpose an orbital arc of upwards of 160° .

As a second case in point, we may mention the circumstances attending the discovery of the comet by Mr. Denning last October, and its previous track. Mr. Denning found it on October 3, the perihelion passage having taken place on September 13, so that it was already at a considerable angular distance from perihelion at the first accurate observation. But prior to arriving at its least distance it had made the following tour of the southern heavens. In the column headed "Intensity of Light," the brightness at discovery on October 3 is taken as unity.

12h. G.M.T.	R.A.	Decl.	Distance from Earth.	Intensity of Light.
June 26 ...	296.1 ...	-33.8 ...	0.481 ...	0.8
July 25 ...	280.3 ...	66.9 ...	0.159 ...	11.9
30 ...	228.5 ...	80.5 ...	0.128 ...	20.4
Aug. 2 ...	158.9 ...	74.9 ...	0.118 ...	25.6
4 ...	143.2 ...	65.6 ...	0.116 ...	27.6
6 ...	136.0 ...	55.6 ...	0.119 ...	27.9
8 ...	131.8 ...	-45.8 ...	0.125 ...	26.5
Sept. 13 ...	129.2 ...	$+11.1$...	0.503 ...	2.9

With anything approaching to a regular examination of the southern sky such an object could not have escaped notice.

CHEMICAL NOTES

WHETHER the atomic weight of uranium is represented by the number 120 or 240, is still a disputed question. Experiments recently conducted by Herr Zimmermann (*Berichte*) are strongly in favour of the latter number. Herr Zimmermann has determined the densities of the various of uranium tetrabromide and tetrachloride, by Victor Meyer's method, at the temperature of a Perrot's furnace; his results are as follows:—

	Sp. gr. of vapour.	Calculated.
		$\bar{U}=120, \bar{U}=240.$
Uranium tetrabromide ...	19.46 (mean of 6) ...	0.68 19.36
Uranium tetrachloride ...	13.33 (mean of 4) ...	6.60 13.21

SEVERAL important papers on general considerations regarding processes of chemical change, by MM. Potilitzin, Beketow, and Kajander, have appeared in the *Journal* of the Russian Chemical Society (good abstracts in *Berliner Berichte*, xiv. 2044–2058). As a deduction from experimental results, M. Potilitzin concludes that in every reaction, whether in presence or absence of water, a division of the elements of the reacting bodies occurs, and this is conditioned by the atomic weights of the elements, and the mass of the reacting substances. Berthelot's principle of maximum work is only applicable when but a single product is formed in a reaction, and when the energy, liberated in the reaction, all appears as heat. But in actually-occurring processes of chemical change there is a conversion of potential into kinetic energy, and subsequent employment of this kinetic energy in the work of fusion, evaporation, affinity, &c. Sometimes a portion of this energy may be used in the formation of compounds wherein heat is absorbed. This change of potential into kinetic energy is counterbalanced by the conversion of energy of motion into heat: a condition of equilibrium for the entire chemical system is thus attained, conditioned chiefly by the atomic weights of the reacting elements, the masses of the chemical substances in the system, and the relative amounts of potential and kinetic energy. The heat evolved in a chemical change

measures the initial velocity of that change; but the final result of the change is dependent on the attainment of a general equilibrium, the conditions of which have been stated. Any change in one or more of these conditions causes a change in the direction of the chemical reaction.

IN the paper of M. Kajander the action of acids on plates of magnesium is considered: it is shown that the velocity of the action is inversely proportional to the internal friction of the liquid: raising the temperature of the liquid acts by diminishing the internal friction.

PROF. MENSCHUTKIN continues to publish, in the *Journal* of the Russian Chemical and Physical Society his researches on the influence of isomerism on the formation of compound ethers, and deals with the etherification of polybasic acids. The researches are rendered difficult by the circumstance that we know but few polybasic acids, the structure of which is well determined. Altogether the etherification of polybasic acids is very like the etherification of monobasic acids; the limits of etherification are always high, if a primary alcohol is taken for the formation of the ether; the rate of etherification varies with the isomerism of the acid, and the variations of the rate are as in monobasic acids. This likeness is the more remarkable, as the reactions are far more complicated in this case than in the preceding one.

PROF. MENSCHUTKIN also discusses the influence of the molecular weight of homologues on the course followed by incomplete and reversed reactions. He has succeeded in establishing that the law of homology, extends as well to the chemical as to the physical properties of homologues, and as well to their complete reactions, as to the incomplete ones.

THE phenomenon noticed by Mills, and called by him "chemical repulsion"—referred to some time ago in these "Notes"—has been recently studied by Herr Lecher (*Wien. Akad. Ber.*), who thinks that there is no need for the new hypothesis of chemical action at a distance introduced by Mills. A few drops of barium chloride solution are placed on the surface of a glass plate, a second plate containing two circular holes is pressed on the first, and a drop of sulphuric acid is introduced at each hole: the formation of barium sulphate proceeds in circles which gradually extend their circumference, but cease to do so before they come into contact. The author's explanation, which is based on several experiments, assumes that the barium chloride molecules originally move equally in all directions through the liquid; the presence of sulphuric acid, however, fixes many of these molecules and prevents their moving out of the sphere of action of the acid: the space between the advancing circles of barium sulphate thus becomes gradually poorer in barium chloride, until finally the whole of this salt is removed: there is a space of no action, because the compounds which react are absent.

HERR SCHULZE (*Journ. für pract. Chem.*) describes an interesting case of so-called "catalytic action." Sulphuryl chloride (SO_2Cl_2) is not formed by the action of chlorine on gaseous or liquid sulphur dioxide, but if these gases be passed over camphor, large quantities of sulphuryl chloride are produced; five grams of camphor sufficed to induce the formation of 470 grams of sulphuryl chloride. Acetic or formic acid likewise induces the combination of chlorine and sulphur dioxide, but these compounds are themselves more or less attacked, whilst camphor remains unchanged at the close of the reaction. Acetic and formic acids dissolve considerable quantities of sulphur dioxide, but other good solvents of this compound, e.g. acetone, fail to induce the formation of sulphuryl chloride.

MALLET (*Amer. Chem. Journ.*) finds the number 1759 as representing the sp. gr. of hydrofluoric acid gas at 25° , hence molecular weight = 39.32. If this determination is confirmed, the formula of the compound in question must be written H_2F_3 , and not, as at present, HF . But if Mallet's formula is correct, the atom of fluorine must be divalent; it has hitherto been regarded as markedly monovalent.

M. L. DE BOISBAUDRAN (*Compt. rend.*) has prepared gallic chloride, Ga_2Cl_6 . The specific gravity of the vapour of this chloride, at 273° , was found to be 11.9, which confirms the formula Ga_2Cl_6 .

AN iron wire embedded in lampblack and heated to redness in the reducing flame of the blowpipe loses weight; a portion of the iron, according to Colson, diffuses into the carbon. This chemist states that solids diffuse into each other when a chemical